

MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXIX.

AUGUST, 1901.

No. 8

INTRODUCTION.

The MONTHLY WEATHER REVIEW for August, 1901, is based on reports from about 3,100 stations furnished by employees and voluntary observers, classified as follows: regular stations of the Weather Bureau, 159; West Indian service stations, 13; special river stations, 132; special rainfall stations, 48; voluntary observers of the Weather Bureau, 2,562; Army post hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Railway Company, 96; Hawaiian Government Survey, 200; Canadian Meteorological Service, 32; Jamaica Weather Office, 160; Mexican Telegraph Service, 20; Mexican voluntary stations, 7; Mexican Telegraph Company, 3; Costa Rica Service, 7. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Commander Chapman C. Todd, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San Jose, Costa Rica; Captain François S. Chaves, Director of the Meteorological Observatory, Ponta Delgada,

St. Michaels, Azores, and W. M. Shaw, Esq., Secretary, Meteorological Office, London; Rev. Josef Algué, S. J., Director, Phillipine Weather Service.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is $157^{\circ} 30'$, or $10^{\text{h}} 30^{\text{m}}$ west of Greenwich. The Costa Rican standard of time is that of San Jose, $0^{\text{h}} 36^{\text{m}} 13^{\text{s}}$ slower than seventy-fifth meridian time, corresponding to $5^{\text{h}} 36^{\text{m}}$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now always reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

During the temporary absence of Professor Abbe, Mr. H. H. Kimball has been appointed Acting Editor of the REVIEW.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

The first month of the season of tropical storms passed without the occurrence of gales of hurricane force at any of the islands of the Greater or Lesser Antilles. The most important storm of the month first appeared as a feeble disturbance in the subtropical region north of Cuba on the morning of the 9th. By the morning of the 10th this disturbance had advanced to the extreme southern part of the Florida Peninsula, with an apparent slight increase in energy. At that time the following advisory message was sent to all Florida stations, and also to Savannah and Charleston:

Disturbance of moderate strength central off southeast Florida coast. May cause squalls dangerous to small sailing craft along Florida coast and over western Bahamas.

During the next twenty-four hours the center of disturbance moved slowly northwestward to the Florida coast south of Tampa, and on the morning of the 11th, the following advisory message was sent to Gulf and south Atlantic stations from New Orleans to Charleston:

Disturbance of slight extent central this morning off the west Florida coast; evidently moving northwestward; may cause severe squalls this afternoon and to-night on the west Florida coast.

By the morning of the 12th the center of the disturbance had advanced to a position over the eastern part of the Gulf of Mexico, with an apparent increase in energy, and coast stations from New Orleans to Jacksonville were again advised of the position and character of the storm. The regular morning and special reports of the 13th showed the advance of the storm toward the mouth of the Mississippi, and at 8 a. m. a wind velocity of 48 miles an hour from the northeast was reported at Port Eads. On that date southeast storm warnings were ordered on the west Florida, Alabama, Mississippi, and Louisiana coasts, and the following message was telegraphed to west Florida and Alabama ports:

Storm center apparently approaching the mouth of the Mississippi. Considered dangerous for vessels bound for middle and west Gulf ports.

Stations on the Louisiana and Mississippi coasts were notified that the storm was increasing in intensity, and would probably cause brisk to high northerly winds the day and night of the 13th.

At 8 a. m. of the 14th Port Eads reported a current wind velocity of 60 miles an hour from the southeast, with a maximum velocity during the preceding twelve hours of 72 miles

an hour from the southeast. Storm warnings were continued along the middle Gulf coast, vessels were again advised that it would be unsafe to leave port, and railroad and other interests were notified that a severe storm and high water were indicated. By the morning of the 15th there was every evidence that the storm possessed hurricane force. Stations on the west Florida and Alabama coasts were informed that the storm would be very severe and dangerous for any class of vessels. The forecast official at New Orleans was authorized to order, at his discretion, hurricane warnings on the Gulf coast from the mouth of the Mississippi westward, and was directed to notify, by all available means, points in Louisiana and Mississippi that severe gales and heavy rain would occur during the next twenty-four hours. Similar advices were also telegraphed throughout Alabama. During the next twenty-four hours the center of disturbance crossed the coast line somewhat to the west of the mouth of the Mississippi, and advanced thence northward over east central Mississippi, where it was central at 8 a. m. of the 16th.

After passing into the interior, the storm showed a rapid decrease in strength. At New Orleans the barometer fell to a minimum of 29.41 inches at 9 a. m. of the 15th, and the maximum wind velocity recorded on that day was 49 miles an hour from the northeast, at 9:35 a. m. At Mobile the storm was most severe from 5:15 to 6:30 p. m. of the 15th, and the wind attained its greatest velocity, 60 miles an hour from the southeast, at 5:50 p. m., with an extreme velocity of 78 miles an hour. Between the hours of 5 and 7 p. m., the wind velocity averaged from 50 to 60 miles an hour. From a short distance west of the mouth of the Mississippi River to a point somewhat to the east of Pensacola, Fla., the storm was very destructive. The forecast official at New Orleans reports that the estimated damage to property on the Louisiana coast amounted to more than \$1,000,000, exclusive of the damage to growing crops. The official in charge at Mobile reports that, according to the estimate of the secretary of the Chamber of Commerce, the value of property saved by the warnings of the Weather Bureau aggregates several millions of dollars.

A detailed description of this storm will be found in the following reports submitted by the Weather Bureau officials at New Orleans and Mobile.

Report by Dr. Isaac M. Cline, Forecast Official, New Orleans, La.:

The 8 a. m. weather map of August 12, 1901, showed a general barometric depression over the Gulf States, and there were conditions along the Gulf coast which indicated that a storm was probably developing in the central Gulf. Attention was called to this in the general forecast at 8 a. m., August 12, and shipping interests were advised to be on the alert.

1 p. m. special observations were called for on this date, but they revealed no material change since morning in the conditions. Some tugs and barges were, however, advised not to go into the Gulf, and the advice was heeded. At 8 p. m. the lowest barometer was 29.82 at Galveston.

The 8 a. m. reports of August 13 showed a storm developing in the central Gulf off the mouth of the Mississippi River, and the following was issued and distributed:

"Storm northeast, 9 a. m., stations along the Louisiana and Mississippi coasts. Disturbance in the Gulf off the mouth of the Mississippi River, increasing in intensity; will probably cause brisk to high northerly winds to-day and to-night."

Several tugs with fleets of barges were held in the basin on the advice of the Weather Bureau. The New Orleans agent of a steamship line, running to Tampico, Mexico, after consulting the Weather Bureau officials over the telephone, wired his correspondent at the latter place to hold his vessel until further notice from the Weather Bureau.

By 8 p. m. the storm had developed considerable intensity. The wind at Port Eads was blowing 48 miles an hour from the northeast. No report was received from Port Eads on the morning of the 14th. The following warning was issued and distributed:

"Continue storm northeast, 9 a. m., along Louisiana and Mississippi coasts; disturbance central in Gulf, off Louisiana coast, moving north; will cause high winds, shifting to west."

All the railroads running into southeast Louisiana and southern Mis-

issippi were requested by telephone to send notice to their agents in these districts that a severe storm and high water were indicated and to be on the alert and prepare for the same. The officials of the companies distributed the information promptly.

By 8 p. m. August 14 the storm had spread into the west Gulf, with the barometer reading 29.66 inches both at Galveston and New Orleans. Notwithstanding the barometric gradients to the westward were slight, storm northeast signals were ordered at Galveston and Sabine Pass, Texas.

At 8 a. m. August 15 the report showed a well-defined hurricane in the Gulf off the coast of Louisiana, and moving slowly toward the northwest. The following warning was issued:

"Continue storm northeast along the Louisiana and Mississippi coasts; storm increasing in severity and moving northward; high northeast to east winds and high water will continue to-day and probably to-night; the tide has risen 7.4 feet in 48 hours."

The following was received from Washington, 10.53 a. m.

"At your discretion order hurricane warnings on the Gulf coast from Mississippi westward; storm undoubtedly of great intensity and will strike the coast between the mouth of the Mississippi River and Galveston."

GARRIOTT.
It was my desire to wait until receipt of 1 p. m. specials, which had been called for, before issuing a hurricane warning for the east Texas coast, but I learned that all the telegraph wires east had gone down, and that only one or two wires north and west remained. On account of the threatening conditions and the probability of all wires going down and making it impossible to get warnings out, I issued a warning at once for the territory between the mouth of the Mississippi River and Galveston, as follows:

"Hoist hurricane signals 11 a. m. along Louisiana and east Texas coasts; storm off the Louisiana coast undoubtedly of great intensity and moving northwest; will probably strike the coast between the mouth of the Mississippi River and Galveston, causing hurricane winds from an easterly direct on on the Louisiana coast and northerly on the east Texas coast."

This warning was supplemented by the following advisory message sent to Galveston:

"Only high north winds indicated for east Texas coast, which will give low water at Galveston."

This was also given to the press so as to allay the fear of those interested in Galveston who would probably read of the storm in the Gulf.

The storm blew with great fury along the immediate coast of Mississippi and Louisiana, commencing on the afternoon of the 13th and continuing through the 14th and 15th. The high wind was not felt at New Orleans until the afternoon of the 14th.

The following are the essential features of the weather at New Orleans on the 14th and 15th:

August 14.—Cloudy, damp, cool, and windy weather; 10 strato-cumulus from northeast at 8 a. m.; 6 alto-stratus from west and 4 cumulus from northeast at 1 p. m.; 10 cumulus from northeast at 4 p. m. and 10 strato-cumulus from northeast at 8 p. m. At 8 a. m. the barometer reading was 29.703; at 1 p. m., 29.720; at 4 p. m., 29.671; at 8 p. m., 29.653, and at midnight, 29.650, which was the lowest reading for the day. The wind blew steadily from the northeast throughout the entire day; at 8 a. m. the velocity was 9 miles an hour; at 1 p. m. and 4 p. m., 20 miles; at 6:40 p. m., 32 miles, and at 8 p. m., 24 miles. Highest velocity for the day, 32 miles an hour. Light showers occurred from 1 to 5:55 a. m., 7 to 7:40 a. m., 8:26 to 9:15 a. m., 10:20 to 11:40 a. m., 12:40 to 2:40 p. m., 5:10 to 5:20 p. m., 6:05 to 7:55 p. m., and from 9:05 p. m. till past midnight. Total rainfall for the day, 0.78 inch. The Mississippi River at this point rose 1.9 foot in the twenty-four hours ending at 8 a. m., and to a stage of 5.9 feet, and two hours later had risen to 7.1 feet, due to the backing of the water, and continued to rise.

August 15.—Wet and stormy morning and forenoon; cool, overcast, and stormy in the afternoon till about 5:45 p. m., when the sun broke through the clouds in the northwest; the evening was cool, partly cloudy, damp, and comparatively quiet. Clouds: 8 a. m., 10 strato-cumulus from northeast; 1 p. m., 10 strato-cumulus from north; 4 p. m., 10 nimbus from northwest; 8 p. m., few cirro stratus from southwest and 9 strato-cumulus from northwest. At 8 a. m. the barometer reading was 29.431 inches, having fallen steadily all the morning; at 9 a. m. it was 29.410, the lowest recorded during this storm; after this it began to rise; at 1 p. m. it was 29.461; at 4 p. m., 29.516; at 8 p. m., 29.566, and at midnight, 29.650. The wind blew steadily from the northeast from early morning till about 10 a. m., then it backed to north with occasional gusts from northeast till about 11:55 a. m., when it backed to northwest for a few minutes; from this time till about 3:45 p. m. the wind blew mostly from north-northwest, and during the remainder of the day from northwest with decreasing energy. From 12:01 to 8 a. m. the wind velocity was from 20 to 35 miles an hour from northeast; at 9:35 a. m. there was a severe squall, during which the wind reached a velocity of 49 miles an hour from northeast; this was the highest velocity recorded for the day; at 1 p. m. the wind was 40 miles from north; at 4 p. m. it was only 24 miles from northwest; at 8 p. m., 15 miles from northwest, and at midnight 8 miles west.

To-day's windstorm is the severest experienced in this city since

1870 with one exception, August 19, 1888, when the wind blew at the rate of 60 miles an hour from the east. The rain that began at 9:05 p. m. yesterday ended at 7:30 o'clock this morning; light showers occurred from 8:26 to 9 a. m., 11:15 a. m. to 12:40 p. m., and 2 to 5 p. m. Total for the day, 0.59 inch. The Mississippi this morning stood at a stage of 11.4 feet, a rise of 5.5 feet in the past twenty-four hours; soon after noon the river began to fall, and after 4 p. m. it fell rapidly.

During August 13 and up to the afternoon of the 14th the storm moved northward. At 8 a. m. of the 14th the wind at Port Eads had changed by the way of the east to southeast, with a maximum velocity of 72 miles an hour. This, with other reports, showed that the storm had moved to the westward of that place. The 8 a. m. reports of the 15th showed the storm moving toward the northwest. During the evening of the 15th the storm changed its course from northwest toward the northeast. The center of the storm appears to have struck the coast of Louisiana to the west of the mouth of the Mississippi River, as forecast in the hurricane warning. It then moved toward the northeast over southeastern Louisiana, the center probably passing between New Orleans and Port Eads, across southern Mississippi into Alabama, and thence northward up the Mississippi Valley.

EXTENT OF DAMAGE.

Much damage and loss of life was reported. It is estimated that the damage to property on the Louisiana coast will amount to more than \$1,000,000, exclusive of the damage to growing crops, which can not be estimated.

The greatest damage in the vicinity of New Orleans occurred at Milneburg and Bucktown, on the shores of Lake Pontchartrain. The West End suffered serious damage. The Old Basin overflowed its banks and inundated a large section of the city, causing much damage, especially in the vicinity of Tremé market, where the streets were covered with water from 1 to 3 feet deep. The Orleans levee board and the city authorities, acting upon information given out by the Weather Bureau, had a force of 500 men at work strengthening the canal levees. By noon of the 15th the water in the basin began to recede, and by sundown it had ceased to flow over its banks.

All the towns south and southeast of New Orleans suffered seriously; also all towns along the Mississippi coast. Only 10 persons are known to have perished, but more lives no doubt were lost. Railroads east and north suffered serious damage. Mail communication with the East was cut off on the night of the 13th and has not yet been restored, August 17.

The warnings issued by the Bureau, well in advance of the hurricane, and the advice that conditions were very threatening, are credited with saving many lives and a vast amount of property, as the following editorial from the Daily States of August 15 indicates:

"SERIOUS DAMAGE PROBABLE."

"The severe storm which has been raging over the Gulf coast of the Southwest during the past two days is quite likely to furnish a chapter of unpleasant reading when all the reports have been made up. The continued force of the wind and wave has resulted in producing a serious situation all down the lower coast, where the water has been backed up even higher than was the case in the great Chenier Caminada disaster, which occurred in October, 1893, and destroyed so many lives. It is greatly feared that the loss of life among the fishermen and others who make their temporary habitation on the low-lying coast and the adjacent islands will be considerable.

"Fortunately, the splendid service of the Weather Bureau, by the timely notice it sent out of the approaching storm, gave many an opportunity to secure protection, and the consequent disaster will be much smaller than would have been the case had the storm broken upon the coast without warning. Communication with many important points is difficult, owing to the fact that the wires are prostrated, but if the storm has prevailed over the principal sugar and rice districts with anything like the same force that characterized its passage over the coast sections the damage to the crops must be considerable.

"The rice crop throughout Louisiana and Texas is just in that condition where the ripening grain will cause the stalks to succumb to heavy winds, and it is feared that the loss resulting will be considerable. The sugar-cane and cotton crops will probably come out better than the rice, by reason of the fact that these crops have not reached that advanced stage of ripeness where the injury done would be irreparable. The chief damage to be apprehended is to life and shipping on the coast and in the Gulf and to the great rice crops of Louisiana and Texas.

"It is sincerely to be hoped that the early and accurate warning given by the Weather Bureau enabled most of those exposed to seek places of safety, which appears to have been the case from reports brought in by several who were on the lower coast at the beginning of the storm."

The Times-Democrat of August 15, 1901, published the following regarding action taken as a result of the warnings:

"High winds prevailed along the coast yesterday afternoon and last night, and the warning sounded by the New Orleans Weather Bureau office was amply justified.

"The advice which Forecast Official Cline gave the owners of vessels of various kinds to keep in port was heeded, and this fact probably tended to minimize the damage resulting from the high wind.

"The timely warning sent out by the Weather Bureau officials yesterday saved many of the vessels from the storm. The Weather Bureau office here early yesterday notified all points all along the Louisiana and Mississippi coast to advise ship owners not to send their vessels to sea. This warning was heeded, for about twelve steamers were stopped at the Head of the Passes and cast anchor, and will remain in the river until the storm has passed over.

"At 4:30 o'clock the Weather Bureau reported the storm to be increasing. The last information received was that the wind was sweeping off the Passes at the rate of 48 miles an hour. It had increased greatly in velocity, and was growing greater in its force all the time.

"The storm was reported to the Weather Bureau officials as being centered south and central of the Passes. It was moving slowly northward.

"It is by far the worst storm of the season," said Captain Ward, of the steamer *Lawrence*, last night, "and I am afraid the worst is yet to come. So far as I have been able to learn there are no boats out on the lake, as the warning came in time."

The Picayune of August 17, 1901, says:

"The merchants along the river front took advantage of the timely warnings of the Weather Bureau, and got their goods up on platforms above high-water mark; so that, comparatively speaking, the damage to stocks of merchandise is small."

The Picayune of the same date, in publishing a sketch of the warnings issued by the Weather Bureau in connection with this storm, says:

"The lesson to be drawn from the above story should be one of confidence on the part of the people in the great and important work done by the Weather Bureau. The uses made of the daily forecasts are so numerous and well known as to call for no remark; but the value to the manifold business interests of the country of the publication of the weather data and the dissemination of the warnings of exceptionally severe and injurious weather conditions should be as fully appreciated as it deserves. Warnings of storms and hurricanes, issued for the benefit of marine interests, are most important and pecuniarily valuable."

The Daily Item of August 17, 1901, makes the following editorial comment:

"The Weather Bureau, by the timely notice it sent out of the approaching storm, gave many an opportunity to secure protection, and the consequent disaster was much smaller than would have been the case had the storm broken upon the coast without warning."

Supplementary report by Mr. H. F. Alciatore, temporarily in charge, New Orleans, La.:

I have the honor to submit the following additional report on the effects of the hurricane of August 13-16, 1901, at the mouth of the Mississippi River, based on mail advices and telegraphic reports from our displayman at Port Eads and Pilottown, La.:

At 8 p. m., August 13, 1901, the barometer at Port Eads was 29.66 inches, and the wind was blowing from the northeast at the rate of 48 miles per hour. Later in the evening the wind increased in force and the telegraph and telephone lines were prostrated and have remained down ever since. At 8 p. m., August 14, a report was filed at the telegraph office by the displayman but was never sent, the line being down. This report showed that the barometer was 29.50 inches, wind from southeast, 60 miles per hour, and that some time during the day the wind had reached a maximum velocity of 72 miles per hour from the northeast.

During the night of the 14th and morning of the 15th the anemometer cups were blown away and the anemometer support knocked down, from which it would appear that a hurricane velocity in excess of that reported in the 8 p. m. observation of the 14th must have occurred. The instrument shelter was washed away. The flagstaff was broken by the wind and fell to the ground. The office building (a small cabin Carre) weathered the storm, but the papers and records therein were soaked with water.

At Pilottown, La., about 12 miles up the river, the storm was equally severe. The large and substantial "lookout" tower from which storm flags were displayed was blown down (probably on the night of the 14th) and completely wrecked. The outhouse in which our displayman was accustomed to sleep was blown down and rapidly filled with water, the tide having risen about four feet in about ten minutes, and property belonging to the Weather Bureau was ruined. The storm-warning lanterns, property of the Bureau, are however, reported to be in good condition. The displayman reports that "it blew a hurricane here (Pilottown) for twenty-four hours from northeast to east-southeast.

Report by Mr. William M. Dudley, official in charge, Mobile, Ala.:

One of the most interesting storms in the meteorological history of this section occurred Thursday, August 15, 1901. On Sunday morning, the 11th, the following advisory message was received from the Central Office, and furnished the public:

"Storm warning at 10:15 a. m., disturbance of slight extent central this morning off the west Florida coast, evidently moving northwestward. May cause severe wind squalls this afternoon and to-night on the west Florida coast."

During Monday, August 12, fresh southerly winds prevailed, with light thunder squalls from the southeast during the afternoon. The following message was received from the Central Office at 3:10 p. m.:

"Advisory 3 p. m., disturbance over eastern Gulf. No evidence of marked energy as yet, but may develop, causing squalls dangerous to small sailing craft in east and middle Gulf."

This information was given out and published by the afternoon press.

On Tuesday, August 13, the storm was central in the middle Gulf, south of Port Eads, La., and at 10:45 a. m., the following message was received from the Central Office:

"Advisory, storm central south of Port Eads, increasing in intensity; will probably move up the Mississippi Valley, and may cause brisk easterly to southeasterly winds on the west Florida, Alabama, and Mississippi coasts."

This information was printed on the morning weather map, sent out over the telephone, and published by the afternoon press. The conditions becoming more threatening as the day advanced the Central Office sent out the following information, received here at 2:10 p. m.:

"Southeast storm warning 2 p. m., Mobile, Pensacola, storm center apparently approaching the mouth of the Mississippi. Considered dangerous for vessels bound for middle and west Gulf ports."

The warning was hoisted at once, and the information given to the public by bulletins, and through the afternoon papers. Several ship captains were advised not to sail.

Light rain began at 11 p. m., of the 13th, and ended at 12:30 a. m. of the 14th; began again at 7:40 a. m., and ended at 7:42 a. m.; amount at 8 a. m., 0.02 inch. A rainbow was observed in the west at 7:40 a. m. Fresh to brisk southeast winds during the night, increased to high during the morning of the 14th, and with the incoming of the tide backed the water of the bay into the river. By noon the water had come awash of the top of the wharfs along the city front, causing some apprehension to business houses located thereon. The office was crowded with people and the telephone rang continually. The southeast wind increased, attaining a maximum velocity of 42 miles per hour at 12:55 p. m., attended by heavy rainfall. Brisk southeast winds prevailed after 1:45 p. m., with showers at intervals, varying from light to heavy. The following message was received from the Central Office at 3:23 p. m.:

"Continue southeast storm warning 3 p. m. Storm central near mouth of Mississippi, apparently moving northward. Unsafe for vessels to leave for west Gulf points this evening or to-night."

This information was distributed by telephone and bulletins. Rain ended at 6 p. m., the amount to 8 p. m. being 0.40 inch. Cloudy and threatening weather all the evening, and fresh to brisk southeast winds to midnight.

On the 15th light rain began at 12:50 a. m. and continued in showers varying from light to heavy through the night, with wind in gusts, varying from fresh to brisk; amount of rain at 8 a. m., 1.67 inch. The day opened stormy and threatening, with high southeast winds after 6 a. m., which attained a maximum velocity of 36 miles per hour at 7:05 a. m.; decidedly cooler, the maximum temperature for the day being 76° and the minimum 74°. There was a slight lull in the wind from 7:30 to 8:40 a. m., when it increased suddenly, attaining a maximum velocity of 41 miles southeast at 8:42 a. m.; it continued high southeast to noon. The barometer fell all the forenoon, and read 29.74 inches at 8 a. m. and 29.65 at noon. The following readings were made during the afternoon, all readings being reduced to sea level: 3 p. m., 29.60; 3:30 p. m., 29.54; 4 p. m., 29.50; 4:30 p. m., 29.47; 5 p. m., 29.42; 5:30 p. m., 29.38; 6 p. m., 29.34; 6:30 p. m., 29.32; 7 p. m., 29.32; 7:30 p. m., 29.32; 8 p. m., 29.32, and 9 p. m., 29.33 inches. All telegraph wires were working badly, and our circuit reports were not received until 11 a. m. On the weather map the following advice was given the public:

"A storm of severity shows on this morning's chart in the vicinity of New Orleans, La. High southeast winds will prevail throughout the day, causing continued high water on the river front at Mobile, Ala., and it is deemed advisable for persons holding perishable goods to move them to a place of safety, as the full intensity of the storm has not been felt, and every indication shows that in its movement it will cause dangerous gales along the coast."

The office was crowded with representatives of business houses on the river front, the telephone rang continually, and merchants prepared to elevate goods on the river front.

The following advisory message was received from the Central Office at 11:20 a. m.:

"Center of Gulf storm approaching coast between mouth of Mississippi and Galveston. Storm becoming very severe. Dangerous for vessels of any class to sail westward to-day."

This information was issued by the afternoon press, to those seeking information at the office and over the telephone, to vessels on the river

front, and to interested persons in general. At 1 p. m. the following was telegraphed to Washington:

"Water over wharf, and three blocks up in the city. Everyone previously warned to move goods."

An effort was made to get information from Fort Morgan, Ala., 30 miles down the bay, on the Gulf, but the wire had been down since early in the morning.

An order from the Central Office to continue southeast storm warning at 3 p. m. was received at 2:30 p. m.:

"Continue southeast storm warning 3 p. m. Hurricane warnings were ordered this morning on Louisiana and east Texas coasts. Storm apparently increasing in intensity. Violent southeast gales will shift to-night to southerly and southwest on Mississippi, Alabama, and northwest Florida coasts."

This information was distributed by the afternoon papers and by bulletin and telephone. Many persons were in the office waiting for advices regarding the storm, and as a result of this warning additional precautions were taken for the removal of goods to higher elevations. It was impossible to send this warning and the advisory message previously received to Biloxi, Scranton, and Fort Morgan, our subdisplay stations, as all wires were down to points west and south of Mobile.

The rain became heavy at 11 a. m., increased with the wind at 3 p. m., and continued until 7 p. m., when the wind shifted to south; total fall from 8 a. m. to 8 p. m., 3.79 inches. Rainfall for twenty-four hours ending 8 p. m. 16th, 5.44 inches; total from the beginning of the storm, 5.84 inches.

The barometer fell at the rate of .05 inch per hour until 6 p. m., and then continued stationary to 8:30 p. m., when the wind shifted to southwest. The barometer then rose rapidly, and watchmen on the river front were informed that the danger had passed.

The wind continued brisk to high southeasterly throughout the afternoon, increased in force after 4 p. m. and continued high until 7 p. m. The storm was most severe from 5:15 to 6:30 p. m., and the time of highest velocity was 5:50 p. m., when a maximum of 60 miles southeast occurred, with an extreme velocity of 78 miles. The wind velocity averaged from 50 to 60 miles an hour between 5 and 7 p. m. After the wind changed to southerly at 7 p. m. it showed a gradual decrease to 22 miles southwest at midnight.

The greatest source of damage feared from the storm was the backing of water into the river, and this continued during the 14th and 15th. The water had been awash of the wharfs from 12 m. to 1 p. m. of the 14th. At 10 a. m. on the 15th it began to come over the wharf, and from this time on it came in very rapidly, rising at the rate of 1 foot an hour. By 1 p. m. it had come up into the streets three blocks above the river front. At 3:30 p. m. the water was 5 feet over the wharf and it continued to rise until 7 p. m., reaching to within half a block of the Government Building, which is located five blocks from the river front. Boats were going about this part of the city. The water began falling when the wind shifted to southerly at 7 p. m. and fell at a rate of about 1 foot an hour.

The height of the water did not equal by 1 foot the stage reached during the hurricane of October 2, 1893. During that memorable storm the water was 6 feet over the wharf, the maximum wind 72 miles southeast, with an extreme velocity of 80 miles, and the water reached the street car tracks on Royal street, one-fourth block farther up than during the recent storm.

During the storm business was suspended throughout the day; merchants everywhere gave heed to the warnings, and as soon as they were received began to move all perishable goods to a safe elevation.

People waded waist deep, directing the moving of goods. Merchants who came to this office late in the evening informed me that, owing to the Bureau's warnings, their losses would be slight.

The warnings issued by the Bureau during the approach of this storm constituted a chain of perfect links. The work of the Bureau was highly commended and appreciated by the community, and merchants do not hesitate to admit that, had they not been notified, their losses would have been incalculable.

The street cars stopped running at 3 p. m. Boats in the river went up to Twelve Mile Island to a safe anchorage. Everything in port was tied fast. No trains arrived during the 16th, and none left.

The office force remained on duty until 12 midnight, when all danger of the storm had passed.

The wind continued fresh from the southwest through the night, and on the morning of the 16th it had diminished to light, with clear and cool weather, in marked contrast with the conditions of the previous day.

The streets were littered with limbs of trees, and the river front was strewn several feet deep with drift wood. Immense saw logs three feet in diameter had floated up the street to within a half block of the Government Building, or four and one-half blocks above the river front.

The damage within the city was slight. The Bay Shell Road a mile below the city from Frascati to Monroe Park, and points below, was washed away entirely. A number of small craft, mostly private sailing yachts, were lost. Bath houses along the eastern shore of Mobile Bay, and along the Gulf coast between Mobile and New Orleans, were washed away. Most of the damage reported from these districts was

due to the high tides. No loss of life is reported, and vessels coming in later, while damaged to some extent as to rigging and sail, rode safely through the storm.

The captain of the steamship *Esperanza* reports that he first encountered the storm in the Gulf Monday, August 12, at 2:30 p. m., with wind 20 to 30 miles, which gradually increased through Tuesday and Wednesday, until a maximum was reached Thursday between 2 and 7 p. m., the barometer falling steadily all the while. The wind was estimated to be between 60 and 70 miles an hour from the southeast. The Gulf was very rough, and waves broke over the funnels. Between the hours of 2 and 7 p. m., Thursday, there was so much spray that it was impossible to see where the boat was going. The captain and the entire crew had remained on watch for three days and nights, and were in an exhausted condition when they reached port Friday morning.

The secretary of the Chamber of Commerce informed me that the amount saved by the warnings could not be estimated, but would aggregate several millions of dollars.

Aside from advices issued in connection with the middle Gulf coast storm, no special forecasts or warnings were required in the United States; neither were hurricane warnings ordered, nor were they needed, in the West Indies.

The forecast center for the west Gulf district was closed at Galveston, Tex., August 5, and opened at New Orleans, La., August 8, 1901.

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

| Number. | First observed. | | | Last observed. | | | Path. | | Average velocities. | |
|------------------------|-----------------|---------|----------|----------------|---------|----------|---------|-----------|---------------------|---------|
| | Date. | Lat. N. | Long. W. | Date. | Lat. N. | Long. W. | Length. | Duration. | Daily. | Hourly. |
| High areas. | | | | | | | | | | |
| I..... | 1, a. m. | 50 | 120 | 6, p. m. | 46 | 80 | 3,300 | 5.5 | 600 | 25.0 |
| II..... | 5, a. m. | 51 | 114 | 9, p. m. | 41 | 70 | 3,425 | 3.5 | 593 | 23.9 |
| III..... | 9, p. m. | 49 | 104 | 13, a. m. | 48 | 53 | 2,750 | 3.5 | 786 | 32.7 |
| IV..... | 11, p. m. | 45 | 67 | 19, p. m. | 46 | 60 | 825 | 1.5 | 550 | 22.9 |
| V..... | 18, a. m. | 53 | 121 | 22, p. m. | 46 | 60 | 3,625 | 6.5 | 558 | 23.2 |
| VI..... | 17, a. m. | 53 | 121 | 22, p. m. | 46 | 60 | 3,625 | 6.5 | 550 | 22.9 |
| VII..... | 22, p. m. | 54 | 114 | 26, a. m. | 42 | 76 | 2,300 | 2.5 | 657 | 27.3 |
| VIII..... | 25, a. m. | 50 | 100 | 28, p. m. | 46 | 60 | 2,150 | 2.5 | 614 | 25.6 |
| | 28, a. m. | 51 | 114 | 31, p. m. | 49 | 86 | 1,425 | 3.5 | 407 | 17.0 |
| Sums..... | | | | | | | 21,825 | 36.5 | 5,415 | 235.5 |
| Mean of 9 paths..... | | | | | | | 2,425 | | 602 | 25.1 |
| Mean of 36.5 days..... | | | | | | | | | 598 | 24.9 |
| Low areas. | | | | | | | | | | |
| I..... | 1, a. m. | 44 | 104 | 3, a. m. | 48 | 68 | 2,000 | 2.0 | 1,000 | 41.7 |
| II..... | 4, p. m. | 51 | 114 | 7, a. m. | 48 | 90 | 1,625 | 2.5 | 650 | 27.1 |
| III..... | 4, p. m. | 32 | 100 | 7, p. m. | 48 | 68 | 2,375 | 3.0 | 791 | 33.0 |
| IV..... | 7, a. m. | 44 | 116 | 11, a. m. | 45 | 64 | 2,700 | 4.0 | 675 | 28.2 |
| V..... | 9, a. m. | 21 | 78 | 19, p. m. | 42 | 88 | 2,275 | 10.5 | 217 | 9.0 |
| VI..... | 21, p. m. | 35 | 98 | 24, a. m. | 48 | 68 | 1,625 | 2.5 | 730 | 30.4 |
| Sums..... | | | | | | | 12,800 | 24.5 | 4,063 | 169.4 |
| Mean of 6 paths..... | | | | | | | 2,133 | | 677 | 28.2 |
| Mean of 24.5 days..... | | | | | | | | | 522 | 21.8 |

For graphic presentation of these highs and lows see Charts I and II.—Geo. E. Hunt, Chief Clerk Forecast Division.

RIVERS AND FLOODS, AUGUST, 1901.

The Mississippi River mean stage was about 3.5 feet lower than during July, 1901, with the greatest fall below the mouth of the Ohio River. The fall was steady throughout the month above Cairo, Ill., but below that place it was interrupted about the middle of the month by heavy rains and for ten days thereafter there was a steady rise, the maximum stages occurring between the 27th and 31st. The maximum stage of 11.4 feet at New Orleans, La., on the 15th, however, was due neither to the rain nor to the rise from the upper river, but to backwater from the high Gulf tide that occurred during the tropical storm in progress at that time.

The Missouri and Ohio rivers presented nothing of special

interest, and both were somewhat lower than during the preceding month.

In the Tennessee, Cumberland, and the rivers of the South Atlantic States, conditions were widely different, the heavy rains of the middle of the month causing flood stages generally, except along the Cumberland where the danger lines were hardly reached. In the Tennessee, danger line stages were general from Chattanooga to the mouth of the river. The following report on the general conditions of the Tennessee River for the month, from the head waters to Bridgeport, Ala., was prepared by Mr. L. M. Pindell, official in charge of the United States Weather Bureau office at Chattanooga, Tenn.

The month opened with the river below the safe navigable stage for large boats and with a continuation of the drought which had prevailed since June 8. On the 5th, light rain was reported over the river system with a slight rise at Clinton, Tenn., and a storm center over the lower Mississippi Valley which moved northeastward to north Georgia, producing heavy rains in front of its center ranging from 0.91 inch at Kingston, Tenn., to 3.24 inches at Rogersville, Tenn. The storm then moved northward along the Atlantic coast with heavy rain over the extreme headwaters. The French Broad and Holston rivers rose rapidly, producing a 10-foot rise at Knoxville, Tenn., by the morning of the 7th and opening navigation at Chattanooga, Tenn. The river then rose to 12.2 feet by 8 a. m. of the 9th and afterwards fell slowly. Light drift was general on the 8th, 9th, and 10th. Rain began on the 10th and continued on the 11th and 12th, but was not very heavy except at Riverton, Ala., where 1.68 inches fell in twenty-four hours ending 8 a. m. of the 11th. On the 13th heavy rain was reported over the Tennessee Valley, the headwaters, and in North Carolina, and continued on the 14th and 15th over the same sections, extending also into South Carolina, Georgia, and Virginia. This heavy rain very probably resulted from the influence of the storm which was centered over the Gulf and which moved northward, east of the Mississippi River from the 14th to 17th, accompanied by heavy rains. The tributaries rose rapidly after the 13th, and on the 15th a rise of 13 feet was reported at Clinton, with the river 1.7 feet above the danger line, 10.5 feet at Kingston, 6.5 feet at Knoxville, and 7.5 feet at Chattanooga. Clinton had a rise of 20.9 feet in forty-eight hours and Kingston 14 feet. On the 16th at 8 a. m. the river at Chattanooga stood at 27.3 feet, showing a rise of 13.3 feet in twenty-four hours.

All the tributaries, and the Tennessee, at Knoxville, were falling at 8 a. m. of the 17th, but still rising slowly at Chattanooga. The water passed the danger line at Chattanooga at 11 a. m. and reached the crest of 33.3 feet between 11 p. m. and 12 m. The reports were all delayed on the 14th, but when received, the following flood warnings were sent to Knoxville and Kingston. To Knoxville: "Additional advices from headquarters indicate rapid rise in river, and it will reach 25 or more feet at Knoxville by Thursday noon." To Kingston: "Heavy rains over headwaters of Clinch; river will rise rapidly, reaching 20 or more feet by to-morrow night (15th); notify river interests." On the 15th when Clinton reported a 13-foot rise the following flood warning was sent to Kingston: "River at Kingston will reach 31 or 33 feet. Heavy rise and rainfall above you." On the 15th the conditions justified a prediction of from 38 to 40 feet at Chattanooga by Saturday morning, but on the afternoon of the 16th the crest was lowered to 36 feet by Saturday noon or evening. The river interests above this city had from thirty-six to forty-eight hours notice, and at and below this city from two to seven days warning. The lower river interests were kept posted by bulletins and telegrams as to the conditions and forecasts. The loss was not as heavy as anticipated owing to prompt measures taken. Considerable damage occurred on the Southern Railway near the Watauga River, also on other roads in that vicinity. The road beds were made soft by the continuous heavy rains and trains ran slow and cautiously. The river bottoms suffered the most; all crops being practically ruined. The drift was heavy from the 15th to the 17th, and consisted of live hogs, dead animals, small buildings, fences, trees, logs, etc. This rise in August was unprecedented, passes all recollection of the oldest inhabitants, and breaks all records as to tide in river and amount of rainfall. During this freshet the heaviest rainfall for the period and for twenty-four hours was at Clinton. From 8 a. m. August 10, to 8 a. m. August 13, or in eight days, the total amount of rainfall at each station in the Tennessee River system was as follows:

| | Inches. |
|------------------------|---------|
| Asheville, N. C..... | 3.61 |
| Murphy, N. C..... | 4.87 |
| Bryson, N. C..... | 6.98 |
| Speers Ferry, Va..... | 5.47 |
| Tazewell, Tenn..... | 8.07 |
| Bluff City, Tenn..... | 4.67 |
| Greeneville, Tenn..... | 4.58 |
| Rogersville, Tenn..... | 4.18 |
| Clinton, Tenn..... | 9.80 |